SAFE WORKING PRACTICES FOR SF6 GAS INSULATED EQUIPMENT

SCOPE

This safe work practices list the procedures required to perform normal and trouble maintenance work safely on SF6 gas insulated apparatus.

Employees shall use these procedures to perform work on SF6 gas insulated apparatus.

A. INFORMATION ON SULFUR HEXAFLUORIDE GAS

1. SF6 gas is odorless, tasteless, colorless, nontoxic and extremely stable in its pure state.
2. SF6 gas is heavier than air and tends to collect in low places. While SF6 is nontoxic, it can exclude oxygen and hence can cause suffocation. When entering a pit area beneath equipment or a vessel that has previously contained SF6 an oxygen test shall be made. Oxygen concentration shall be greater than 19.6%.
3. Toxic decomposition products are formed when SF6 gas is subjected to an electric arc. The more toxic sulfur fluorides are in a gaseous form while less toxic metal fluorides are the solids or powder that may be found in the tank. The amount of decomposition is a function of the intensity and duration of the arc. Personnel shall avoid contacting this powder with exposed skin.
4. Toxic gases should be expected if arcing or corona discharge have occurred in the SF6 gas. The decomposition gases are toxic and may have the characteristic odor of rotten eggs. Avoid inhaling the noxious gas. Personnel should never use their nose to try to determine a section of faulty equipment by smell.

B. EFFECT ON THE BODY

1. "Company" personal have experienced, chemical burns, nose bleeds, head aches and nausea in the past due to exposure of faulted SF6 gases.
2. Unprotected skin may be subject to a rash from either the white powder resulting from an arc, or from the solvent used for cleaning. Contact with solid decomposition products to the eyes or lungs could, cause extreme eye irritation and damage, and severe lung damage. In such cases, and as soon as noticed, the affected parts should be washed with copious amounts of water prior to the employee being seen by a physician.

C. INSPECTION PROCEDURE PRIOR TO INTERNAL FAULTED MAINTENANCE WORK

1. A Drager sample shall be taken prior to opening the equipment to determine if the SF6 gases have experienced an internal fault. If the Drager sample indicates there has not been an internal fault proceed with regular maintenance procedures. **If the Drager sample indicates there has been an internal fault a SF6 sample shall be taken and sent in for analytical results to determine the levels of Contaminant and Decomposition Product and then proceed with TROUBLE MAINTENANCE PROCEDURES.**

D. INTERNAL FAULTED EQUIPMENT MAINTENANCE WORKING RULES

1. Reclaim SF6 via the F-25 scrubber tower.
2. Sample the SF6 at the Reclaimer side of F-25 tower (sampling valve) at ten to fifteen minute intervals, sample with Drager using sulfur dioxide Drager tube. **If Drager testing indicates the F-25 tower is becoming saturated with Contaminant and Decomposition Product (by obtaining readings over threshold limits) discontinue reclaiming SF6 gases and change Chemicals in F-25 tower. ALWAYS WEAR PROPER PPE WHILE CHANGING CHEMICALS IN F-25 TOWER.** Continue to follow this procedure until all SF6 has been removed and is beginning to pull a vacuum on the PCB tank. Discontinue to sample but continue to pull vacuum until the PCB has approximately 2MM of vacuum. At this point the SF6 Reclaimer can be shut down and all valves closed.
3. It has been a good past practice to Scrub the SF6 inside Reclaimer for approximately 8 hours, this will help remove some of the **Contaminant and Decomposition Product** that may have passed through the F-25 tower and internal filters should Scrub SF6 inside Reclaimer.

4. After breaking vacuum in PCB tank with compressed dry air the PCB manhole cover can be removed. Purge PCB tank with dry air with one to two cylinders.
5. Using the air exchanger on the sucking mode, ventilate the PCB for approximately 20 minutes.
6. Fill out and post **PERMIT SPACE FORM,** fill out the **HAZARD ASSESMENT FORM,** and the **RESPIRATOR FIT FORM.**
7. Foreman will lead the group in a discussion about the proper safety practices, rescue routine, special hazards, and the procedures that are going to be used to get the job accomplished safely and in a timely manner.
8. Employees shall begin continuous monitoring with CMX monitor and continuous ventilation with air exchanger before and after entering vessel.
9. An attendant will be designated and posted at the door and his duties will be limited so that his attention will be directed to the employees inside the PCB.
10. After Attendant and the two employees who are entering the confined space are gear up with all of the proper PPE for troubled maintenance (see section on PPE) it is now safe to enter the PCB tank.
11. Vacuum as much of the by-products as possible using a Hepa Vacuum cleaner with a .2 micron filter.
12. Wide down the inside of PCB with alcohol while periodically monitoring alcohol fume levels with a Drager and alcohol Drager tube or CMX. **Alcohol levels are not to exceed 400ppm or 5% on the LEL scale of the CMX.** (Continuous ventilation will assist in keeping alcohol fume levels to a minimum.
13. Begin disassembly of the PCB parts and handing the pieces out to be wiped again and if necessary further disassembly. All of this exterior work should be done on temporary tables and working platforms. Do not place any PCB parts inside of the maintenance trailer until they are wiped and thoroughly cleaned. **At this time the PCB parts are declared decontaminated and can be moved inside of maintenance trailer.**
14. This procedure will be followed until all PCB parts are removed from PCB, the inside of PCB is wiped again and parts are disassembled, wiped and cleaned.
15. Now the job site will no longer be classified as a PERMIT SPACE.

E. INSPECTION PROCEDURE PRIOR TO NORMAL MAINTENANCE WORK

1. Evacuate SF6 gases from apparatus into SF6 Reclaimer.
2. Pull a vacuum on the apparatus to 2mm then break vacuum with compressed dry air.
3. When opening apparatus, personnel shall be properly suited up with coveralls, gloves and full-face cartridge respirator. (See PPE section.)
4. **Without entering apparatus**, inspect for presence of arc products.
5. If no powdered arc products are found, proceed as per Normal Maintenance Procedures

F. NORMAL MAINTENANCE PROCEDURES

1. Purge apparatus with air exchanger for 20 minutes. Personnel shall stand clear of apparatus during this operation.
2. Fill out and post **CONFINED SPACE FORM,** fill out the **HAZARD ASSESMENT FORM,** and the **RESPIRATOR FIT FORM.**
3. Foreman will lead the group in a discussion about the proper safety practices, rescue routine, special hazards, and the procedures that are going to be used to get the job accomplished safely and in a timely manner.
4. Employees shall begin continuous monitoring with CMX monitor and continuous ventilation with air exchanger before and after entering vessel.
5. An attendant will be designated and posted at the door and his duties will be limited so that his attention will be directed to the employees inside the PCB.
6. After Attendant and the two employees who are entering the confined space are gear up with all of the proper PPE for normal maintenance (see section on PPE) it is now safe to enter the PCB tank.
7. Wide down the inside of PCB with alcohol while periodically monitoring alcohol fume levels with a Drager and alcohol Drager tube. **Alcohol levels are not to exceed 100ppm.** (Continuous ventilation will assist in keeping alcohol fume levels to a minimum.
8. After all parts inside of apparatus and inside of tank are wiped clean the full-faced respirators may be removed. Recommend personal continue to wear latex gloves and disposable coveralls.

G. DISPOSAL OF ARC PRODUCTS

1. Disposal of solid arc products shall be done outdoors since the corrosive or toxic gases may evolve from the solid products or absorbents.
2. All materials obtained and used in the clean up operation shall be placed in a 55-gallon drum with approxamentaly 3 lbs of Sodium Carbonate (Soda Ash) on top of such material. Water shall then be added until there is a minimum of 24 inches above the refuse material. The resulting solution will be mildly alkaline and some bubbling of CO2 gas may be noted. Sieves and desiccants could react quite vigorously in a soda ash solution and could splatter nearby personnel. If neutralization is to be performed and tested add the desiccants slowly to the solution and make sure the person handling this operation uses protective clothing including rubber gloves, splash proof goggles, and a face shield or full faced respirator. After standing for one hour the material and water can then be tested for acidity with pH paper and then be disposed of as prescribed by "Company" Environmental Department.
3. The molecular sieve in the apparatus is subjected to minimal quantities of arc products from normal fault clearing operation of the breaker. At each normal maintenance period, this sieve and desiccants shall be disposed of in a landfill operation.

H. LIST OF REQUIRED EQUIPMENT FOR TROUBLED MAINTENANCE

1. Disposable coveralls – "Tyvec" c "Durafab", or equivalent – paper disposable with nylon reinforcing, complete with hood.
2. Non-disposable Neoprene Gloves – 14" (Should be washed in water and dried after use.)
3. Non-disposable Rubber Boot – 17" over the shoe style (Should be washed and dryed after each use)
4. Supplied Air-Line Respirator – Full face pressure demand air line respirator.
5. Air Exchanger – Electric with a speed setting of at least 1200 cfm, complete with compatible flexible duct and duct carrier.
6. Vacuum Cleaner – Industrial wet or dry type with non-metallic attachments, micro staphicidol filter element (particles to .3 microns), 2-15' lengths of plastic hose and coupler. Complete details are as follows:
   1 – Tailor-Mate Delux Wet/Dry Vacuum Cleaner, 1.25 h.p. complete with Micro-Staphicidal Filter adapter – (Cat. No. 670228-6)
   1 – 40 Liter "Polydur" Tank
   1 – Coupler for above hoses (Cat. No. 632409-9)
   1 – 14" Plastic Crevice Tool (Cat. No. 638867-2)
   1 – Micro Staphicidal Filter (.3 microns) disposable (Cat. No. 67336-4)
7. CMX Monitor
8. Drager Kit: NATDR 4053474, Kit Pump (Accuro Deluxe 2265), NATDRA53907 2100-8047D
9. Drager Tubes: Alcohol
10. Drager Tubes: Sulfur Dioxide

I. LIST OF REQUIRED EQUIPMENT FOR TROUBLED MAINTENANCE

1. Disposable coveralls – "Tyvec" c "Durafab", or equivalent – paper disposable with nylon reinforcing, complete with hood.
2. Disposable Vinyl Gloves
3. Non-disposable Rubber Boot – 17" over the shoe style (Should be washed and dryed after each use)
4. Full Faced Respirator – Full face Comfo II or equivalent with twin cartridges for "Organic Vapors and Acid Gases"i.e.: GMC or equivalent. Must have appropriate NIOSH-MSHA approval.
5. Air Exchanger – Electric with a speed setting of at least 1200 cfm, complete with compatible flexible duct and duct carrier.
6. Vacuum Cleaner – Industrial wet or dry type with non-metallic attachments, micro staphicidol filter element (particles to .3 microns), 2-15' lengths of plastic hose and coupler. Complete details are as follows:
   1 – Tailor-Mate Delux Wet/Dry Vacuum Cleaner, 1.25 h.p. complete with Micro-Staphicidal Filter adapter – (Cat. No. 670228-6)
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